Air Quality Issues and Measurements of Pendleton, Oregon and Nearby Locations

J. Harnden, Sunridge Middle School, Pendleton, Oregon
NASA LaRC Mentors M. Pippin and R. Kollmeyer

Background

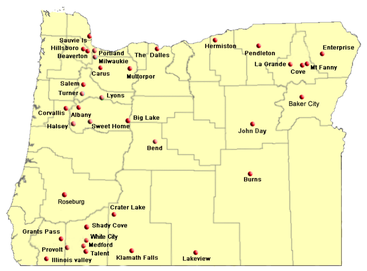


Fig 1 Air monitoring sites of Oregon

The Oregon Department of Environmental Quality monitors and reports air quality data in Oregon. This data is used by cities and counties to determine the Air Quality Index for the area or just to determine the acceptability of outdoor burning, such as agricultural burning.

While occasional fire events can be identified within the data, the overall particulate counts are not excessively high during the warm, dry summer months of fire season, even when the air seems "dirty" when compared to winter data. The highest particulate counts occur during the fall and winter, when high pressure and cold temperatures dominate. Air quality improves when low pressure moves in and wind mixes the air, rather than having the particulates "settle" in low-lying areas. Spring season brings very low particulate counts and improved air quality, however the City of Pendleton rates most days as "yellow" to discourage outdoor burning because of unpredictable winds and rain. The Pacific Northwest endured a record-setting fire season in 2012 with millions of acres of forests and grasslands burned. Brown, smoke-filled skies ruled, with frequent inversions trapping the smoke near the surface in valleys and basins.

Fig 2 Trinity Ridge Fire by Zane Brown

Fig 3 National Weather Service, Pendleton, OR

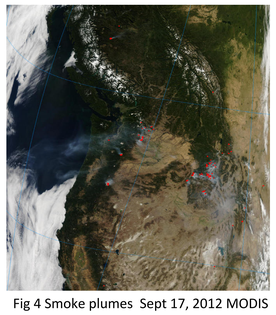


Fig 4 Smoke plumes Sept 17, 2012 MODIS

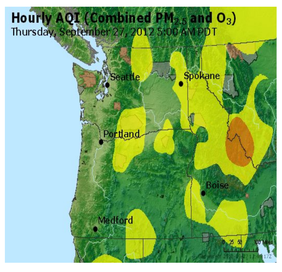
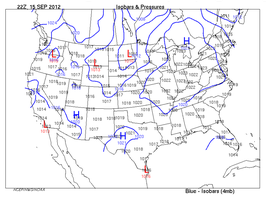


Fig 5 AQI map from AirNow.gov Sept 27, 2012

Weather patterns trapped the smoke for weeks in low-lying valleys, with new fires starting with every dry-lightning storm in the mountains.



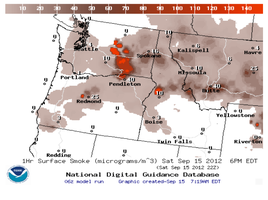


Fig 6 Sept 15, 2012 weather map from AMS and smoke map from NOAA.

References

modis-atmos.gsfc.nasa.gov/IMAGES/index_mod021km.html
www.ametsoc.edu/dstreme
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www.Geology.com
www.epa.gov

Fig 7 Particulate matter sizes

PM 2.5 Data and Conditions for Air Quality

Particulate matter is an important component of air quality. Data is collected and reported by the OR Department of Environmental Quality to the Environmental Protection Agency for use by cities and counties or individuals as part of air quality index calculations. These cities in NE Oregon show similar patterns of increased particulate counts, which follow similar seasonal patterns. Winter sees the highest readings for these rural population centers while spring consistently shows the lowest.

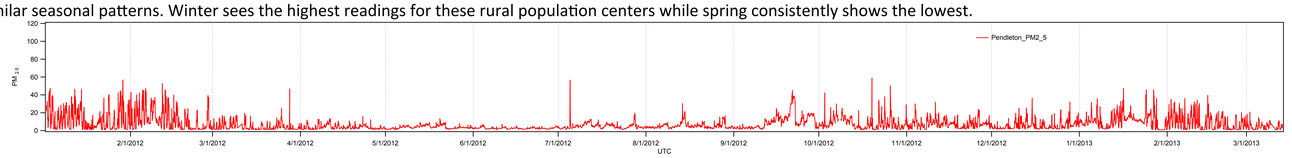


Fig 8 Pendleton, OR $PM_{2.5}$ readings 1/1/12-3/31/13

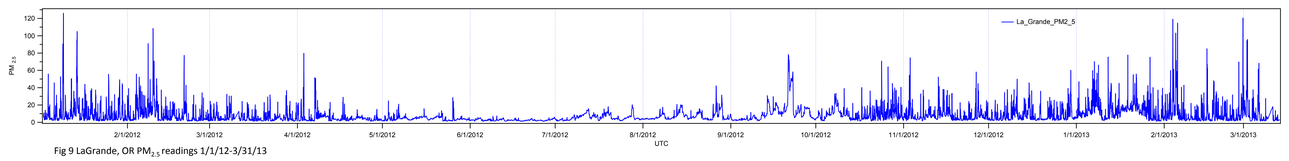


Fig 9 LaGrande, OR $PM_{2.5}$ readings 1/1/12-3/31/13

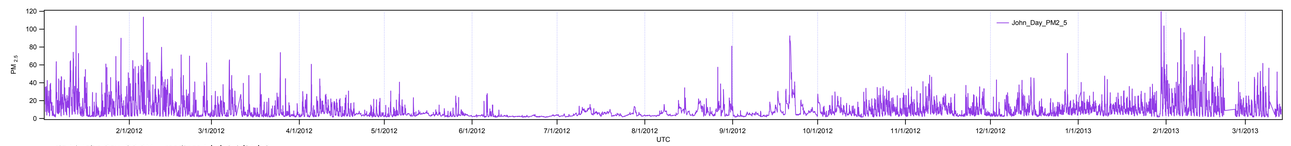


Fig 10 John Day, OR $PM_{2.5}$ readings 1/1/12-3/31/13

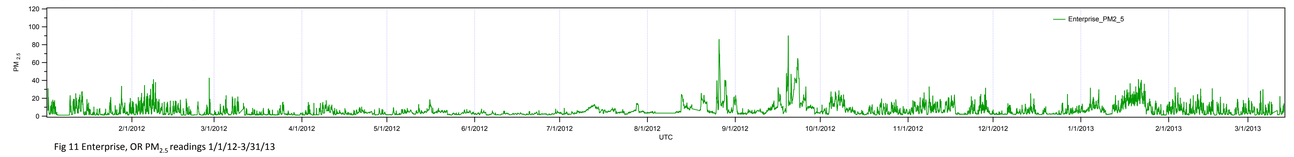


Fig 11 Enterprise, OR $PM_{2.5}$ readings 1/1/12-3/31/13

Fire events occurring locally or regionally are recorded as sudden increases in particulate matter counts either in individual locations from settling smoke or as synchronized readings when smoke is widespread.

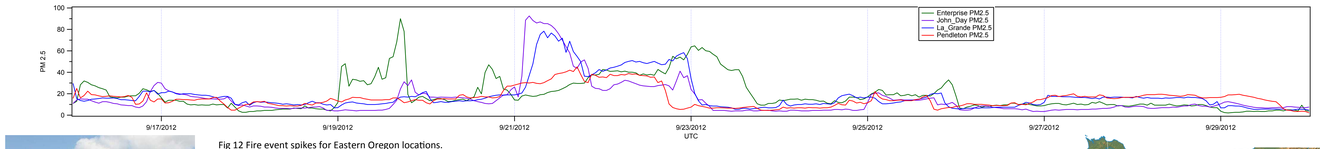


Fig 12 Fire event spikes for Eastern Oregon locations.

Fig 17 Pendleton, OR 05/31/2013

Date	Weather Conditions
09/11/12	smoky/dusty
09/12/12	clear/lt breeze/haze on horizon
09/13/12	brown smoky boundary/low am haze (fog)
09/14/12	hazy/high clouds/WA fires
09/15/12	Hazy east/lt breeze/pm smoky clouds
09/16/12	Hazy/lt breeze
09/17/12	hazy SW/smoky NE
09/18/12	hazy/smoke
09/19/12	very hazy/smoke
09/20/12	smoky/3-5 mi vis/ASA
09/21/12	smoky/5-7 mi vis/ASA
09/22/12	cloudy/lt breeze/Boise vsb >1 mi
09/23/12	cloudy/lt rain/ASA
09/24/12	smoky/hazy/ASA
09/25/12	smoky/hazy/ASA
09/26/12	smoky/hazy/ASA
09/27/12	smoky/hazy/ASA
09/28/12	smoky/hazy/ASA/mnts not visible
09/29/12	Less hazy/improved AQ

Date	Weather Conditions
11/21/12	Pt cloudy/breezy
11/22/12	sunny
11/23/12	cloudy
11/24/12	rain
11/25/12	fog/pm sun
11/26/12	freezing fog
11/27/12	freezing fog
11/28/12	freezing fog/freezing rain
11/29/12	foggy am/windy and warmer pm
11/30/12	foggy am/sunny pm/breezy

Date	Weather Conditions
1/12/2013	pt cloudy/cold
1/13/2013	cloudy
1/14/2013	pt cloudy/ASA
1/15/2013	pt cloudy/ASA
1/16/2013	freezing fog/ASA
1/17/2013	freezing fog/ASA
1/18/2013	freezing fog/ASA
1/19/2013	freezing fog/ASA
1/20/2013	freezing fog/ASA
1/21/2013	freezing fog/ASA
1/22/2013	freezing fog/ASA
1/23/2013	freezing fog/ASA/freezing rain
1/24/2013	clear/pm fog
1/25/2013	rain

Seasonal patterns may be seen in changes in particulate counts from example segments as spring readings are low, while winter is high.

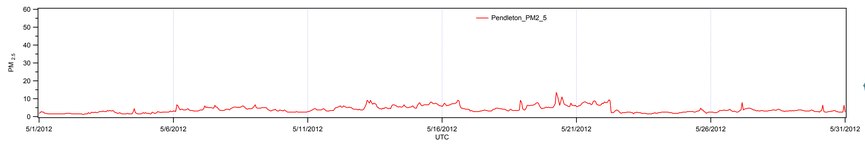


Fig 13 Pendleton, OR 05/01/2012-05/31/2012

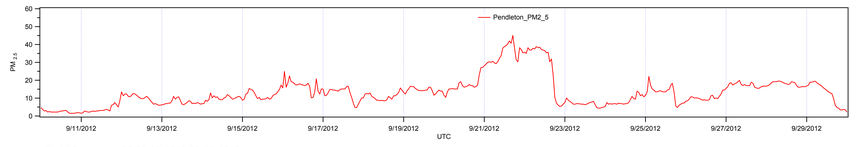


Fig 14 Pendleton, OR 09/10/2012-09/30/2012

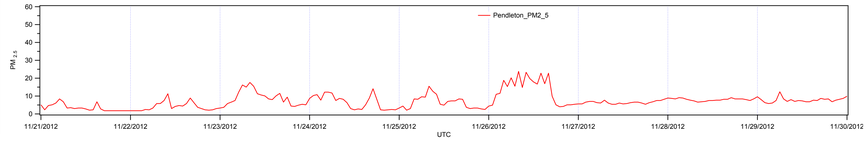


Fig 15 Pendleton, OR 11/21/2013-11/30/2013

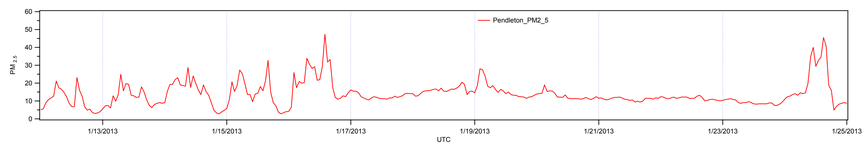


Fig 16 Pendleton, OR 01/12/2013-01/25/2013

Fig 18 Topography of Oregon

Fig 19 Clear spring skies

Fig 20 Summer's dryness brings blowing dust

Fig 21 Athena, OR January 2013 Freezing fog

SMS Student Work

7th grade students at Sunridge Middle School participate in a unit on the atmosphere. Air Quality is an extension of this unit as Pendleton, OR has a recognized problem with air quality. The City of Pendleton supports the science program's air quality unit with a yearly mini-grant and culminating poster contest each term. Approximately 300 students participate during the school year.

During the unit students learn about the composition and structure of the atmosphere. Air pollution issues are investigated, with a focus on Pendleton's unique problems including topography, weather, and climate. Lab activities involve concentration, detection of air pollutants, and physical collection of particulate matter. The beginning lessons regarding air quality introduce local resources and access to daily data. Students make colored data charts matching Air Quality Index colors with particulate matter readings, followed by graphs of local $PM_{2.5}$ and PM_{10} data. Each student graphs one full day, then each graph was posted sequentially, creating one large , continuous graph. This display helped students to see the daily changes, patterns, and correlation between increases and decreases of $PM_{2.5}$ and PM_{10}.

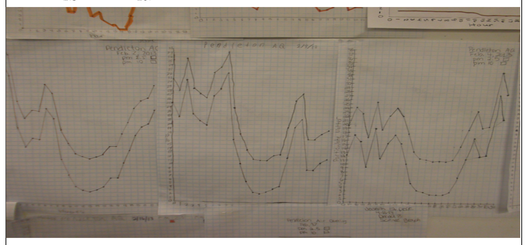
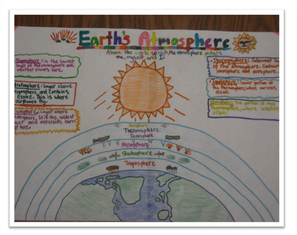


Fig 22 Student graphs of Pendleton $PM_{2.5}$ and PM_{10} for Feb 2-4, 2013. Students quickly noticed how both readings mirrored each other regardless of whether the readings were high or low.



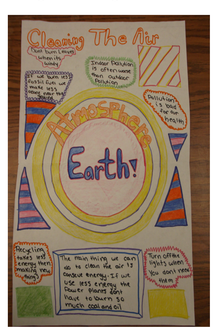


Fig 23 Prize-winning student posters from AQ unit in 7th grade Science

Summary

Pendleton, OR faces seasonal air quality issues due to location, topography and climate factors. The Jet stream may move north or south, leaving stagnant air in place for extended periods in the winter and stationary high pressure builds in the summer, allowing particulate matter from fires, vehicles and wood stoves to settle in the basins. Air Stagnation Alerts are most common in the fall and winter period, especially when cold, Arctic air descends from Canada and Alaska than in the summer, in spite of the smoke from summer fires. Unsettled weather improves air quality in the spring with increased wind and rain. Particulate matter sized 2.5 µg/m³ data was used as the focus of analysis, as reported by AirNow.gov.

Acknowledgements

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